C·A·I

COMPUTER ASSISTED INSTRUCTION LABORATORY

COLLEGE OF EDUCATION · CHAMBERS BUILDING

THE PENNSYLVANIA STATE UNIVERSITY · UNIVERSITY PARK, PA.

A COMPUTER-ASSISTED INSTRUCTION COURSE ON LABORATORY DETECTION OF MALARIAL PARASITES IN HUMAN BLOOD

INTERIM REPORT

FEBRUARY 21, 1968

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The Pennsylvania State University

University Park, Pennsylvania

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Office of Naval Research

Interim Report for a Computer-Assisted Instruction Course on Laboratory Detection of Malarial Parasites in Human Blood

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Report No. 10

This project was undertaken by the staff of the Computer Assisted Instruction Laboratory at The Pennsylvania State University in cooperation with the U. S. Navy in order to examine the feasibility of the new educational technology for solving some of the Navy's world-wide training and retraining problems in the medical specialities. The laboratory detection of malaria in human blood smears was chosen as the subject matter of the course because of the recent increase in the incidence of malaria among U. S. citizens both at home and abroad, and because two nationally known parasitologists, Cmdr. Margaret Lincicome and Dr. Richard Beaudoin, were serving at the National Naval Medical Center, Bethesda, and were interested in developing new techniques of instruction.

The project is, perhaps, unique in that it brought together the three plus years of experience in computer-assisted instruction (CAI) of a University group and the subject-matter competence of Navy scientists. The four principal objectives of the project are as follows:

1) To develop a CAI course in clinical malaria recognition which could serve as a prototype for the development of many specialized courses of study to meet military tropical medical requirements.
2) To demonstrate a functional CAI course in malaria recognition with a view to provoking interest on the part of U. S. Navy medical personnel in the potential of CAI for adapting to other teaching and training needs.
3) To train a small group of Navy personnel in the latest techniques of creating and presenting CAI course material. (An associated objective is the study in this project of the feasibility of physically separating a team of course authors from a team of technical CAI experts.)
4) To evaluate the effectiveness of the CAI course in the recognition of malarial parasites by giving it to a representative sample of Naval medical officers and laboratory corpsmen.

Course Development

At the first meeting of the joint development teams, held in May 1967, the need for identifying behavioral objectives prior to writing instructional material was discussed, and the major behavioral objectives for the program were agreed upon. The experience of Commander Lincicome in teaching malaria diagnosis at Bethesda was heavily drawn upon in the development of the structure and objectives of the course.

After a student has completed the CAI program, the group decided that he should be able to perform the following tasks:

1. To prepare both a thick and a thin blood smear.
2. To recognize and detect malarial parasites and artifacts in 2 x 2 micrographs of both thick and thin blood smears.
3. To identify four plasmodium species in 2 x 2 micrograph of both thick and thin blood smears.
4. Use a microscope to make an accurate diagnosis from a set of unknowns on prepared slides.

A flow chart of the computer based course was prepared, using the major behavioral objectives to determine the course segments. (See Appendix A.)

Since the course was being developed for two target populations (physicians and hospital laboratory technicians), an option to enter a particular segment was provided; thus the need for a control block in the flow chart. The physician or experienced technician in malaria diagnosis may elect to enter any one of the instructional blocks before being given the criterion test. The novice technician is not to be given this option.

The instructional segment (Block 18) of the stage discrimination segment follows a linear format. An instructional statement is presented, followed by a relevant question. If the student's response is correct, he is told that it is correct plus why it is correct. If an anticipated wrong response is made, an explanation of why it is wrong is provided. If an unanticipated response is made, the student is told to check his responses for typing or spelling errors and to try again. A second unanticipated response will produce the

correct response typed out for the student. If the student attempts to proceed without responding, he is informed that it is to his advantage to attempt an answer, and is provided again with the instructional statement. Appendix B shows two representative frames with student interaction.

The instructional material in Block 18 is subdivided into smaller units. At the end of each unit, a criterion test is given. A sufficient number of items are provided in the test in an attempt to identify accurately the achievement of the behavioral objectives set forth for the unit. For those behavioral objectives that were not met, remedial instruction is provided. This instruction is not a reiteration of the original material. It is assumed that the original material did not produce the intended behavior, therefore, the remedial instruction is structured differently.

Extensive use is made of 35 mm slides. This was deemed necessary because the ultimate task of the student will be to identify the several developmental stages of the parasite and to distinguish between the four major species of plasmodium. The identifying characteristics of each stage are first presented through photographs of drawings which emphasize the characteristics. When the student's response indicates that he can identify the characteristics being taught, the student is then shown a photomicrograph of a blood smear that contains at least one infected red blood cell in which the characteristics under study are quite evident.

When the student has responded satisfactorily on the subparts of the stage discrimination instructional segment, he enters the drill segment of the program where a series of photomicrographs of blood smears containing red blood cells infected with malarial parasites in various stages of development are presented to him. The student must identify the stage by typing the stage name. During the first series of slides, the student is provided with knowledge of results and informative feedback to his responses. In subsequent series of the drill, no knowledge of results or feedback is provided on the theory that the student can, by this time, provide self-checking of his own answers.

The last series of slides in the drill sequence is utilized as the criterion test for the stage discrimination. If criterion is met, the student proceeds to the species discrimination section of the program. If criterion is not met, the student is sent through the detailed stage discrimination section a second time.

The species discrimination segment of the course has a format similar to that of the stage discrimination segment, with two important exceptions; the instructional mode has been changed from expository to a discriminatory task, and the student develops a chart that summarizes the diagnostic features of each species. When criterion is met on the species diagnosis test, the student is then given the off-line criterion test. In this test, the student will be asked to make a diagnosis from his observations of a series of slides viewed with a microscope. An analysis of his performance on this test will suggest the remedial instruction necessary if criterion is not met.

One major purpose of the present project was to demonstrate a functional CAI course in malaria recognition with a view to provoking interest on the part of the U. S. Navy medical personnel in the potential of CAI for adapting to other teaching and training needs.

Previous experience by the CAI staff with live exhibits had shown that short segments of course material were perferred for "hands-on" demonstrations. With this as a guideline, the course construction teams decided to develop five short segments; 1) the instructional portion of stage discrimination, 2) the instructional portion of species discrimination, 3) the summary chart for species discrimination, 4) the drill portion of the stage discrimination, and 5) the drill portion of the species discrimination segment. It was felt that the development of these segments in this manner would also provide the course construction teams with feedback concerning the desirability of completing them for instructional purposes. This approach to course development also permitted the optimum utilization of the various talents of the members of the course construction team.

Positive feedback from live demonstrations held in Philadelphia, Washington, D. C., and Cambridge, encouraged the development of the course segments as initially conceived. At present, the diagnostic test, the instructional segment, and a portion of the drill segment have been completed and tested by naval medical personnel at Bethesda. Revisions to portions of the instructional segment are now being made on the basis of student performance records.

Demonstration

A demonstration of segments of the malaria diagnosis course was conducted at the annual meeting of the American Society of Tropical Medicine and Hygiene, October 31 - November 3, 1967, at the Benjamin Franklin Hotel, Philadelphia. An IBM 1050 audio-visual terminal connected to the IBM 1410 computer at the University Park campus by a data line, was set up in a room adjacent to the convention hall at the hotel. Five 8 ft. x 4 ft. plywood panels were used as a backdrop for the display. These panels contained information about CAI, the flow chart of the course, and the purpose of the malaria detection course. "Hands on" demonstration of the CAI material was available to the 500 - 600 participants at all times during the convention. In addition, a brochure containing essentially the same information that was on the panels was distributed to the convention delegates. Members of the Bethesda course development team and the Penn State CAI staff were available to discuss the course content with interested participants.

From December 5 thru December 7, the demonstration segments of the malaria course material were made available on two student terminals at the PROJECT ARISTOTLE meeting held at the Washington Hilton Hotel, Washington, D. C. The members of the Bethesda and Penn State staffs were again available for discussion of the malaria project.

A third demonstration was held at Harvard University, Cambridge, Massachusetts, February 13 - 14. Sponsored by the Office of Naval Research under contract with Entelek, Inc., this group of approximately 100 participants

from all parts of the country, considered the applications of CAI to the whole field of medical education. The development of the Navy-Penn State malaria detection course was described by a panel composed of Cmdr. Margaret Lincicome, Cmdr. Mary Hawthorne, Dr. Richard Beaudoin, and Mr. Robert Igo.

Equipment

During the three month period, June through August, 1967, a student station at Bethesda, consisting of a modified IBM 1050 typewriter with computer-controlled slide projector and audio device, was connected by a long distance telephone line to a 7010 computer at the IBM Corporation's Yorktown Heights, New York facility. A terminal already in the CAI Laboratory at Penn State was also capable of being dialed into the same computer. A dedicated telephone line between University Park and Bethesda enabled the two teams to communicate directly regarding the development of the course material.

Beginning September 1, 1967, the stored program material was transferred from the IBM 7010 to the IBM 1410 computer located in the Computation Center at University Park. Since that date, the direct telephone link between the two institutions has been used to carry conferences on the course development as well as the students' interaction with the computer program.

Future Activities

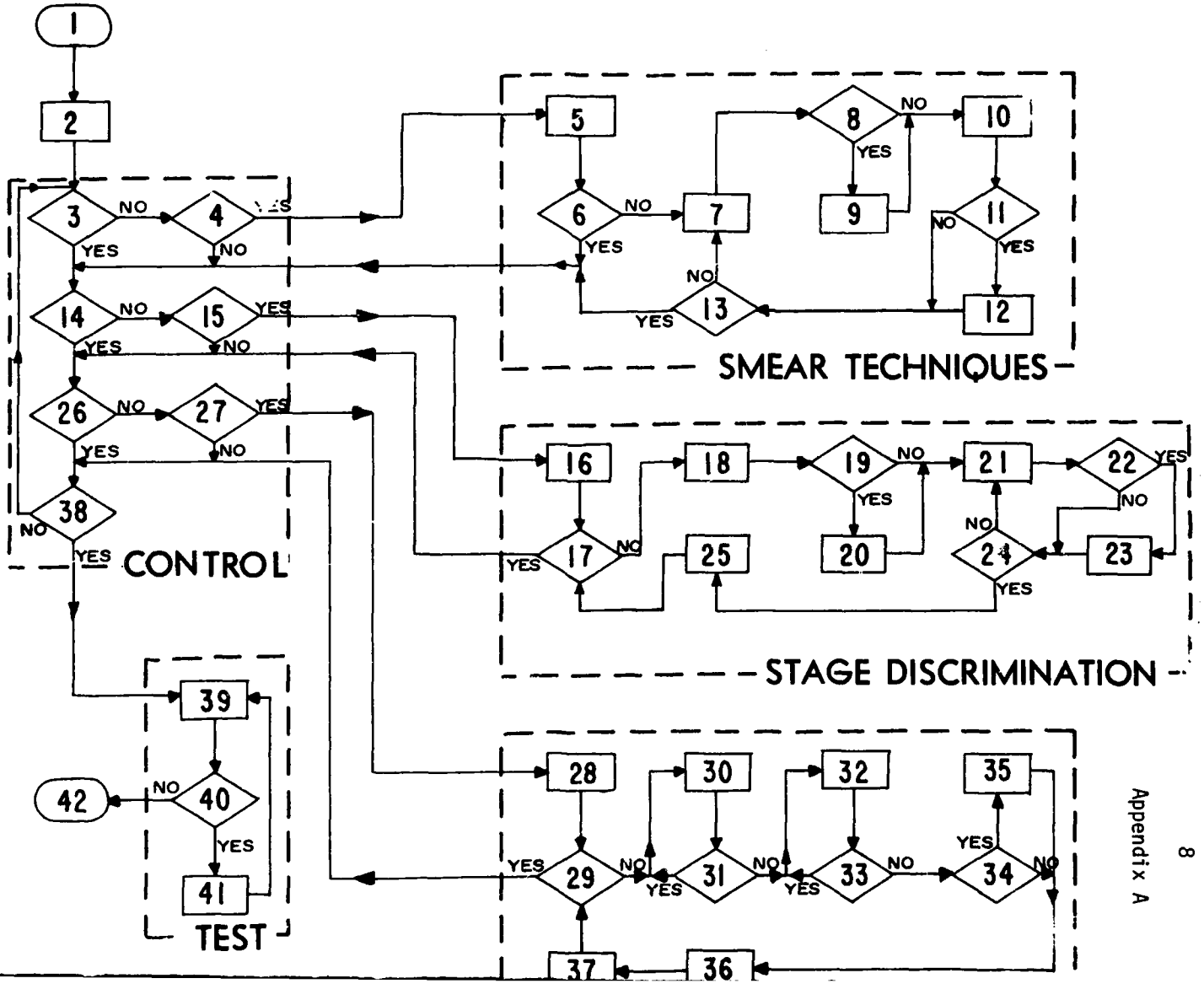
During the next four months, March - June, 1968, the malaria detection course will be completed and it will be administered to a group of 20 students at Bethesda. Careful records of student performance will be kept for summary and evaluative purposes.

Beginning July 1, 1968, we have proposed a one-year extension of our present contract in order to accomplish the following:

1) Translate the existing, but as yet unfinished course in malaria detection from the course language of the IBM 1410 to Coursewriter II, the language of the IBM 1500 system.

2) Conduct three course revisions or optimization cycles on the translated material in order to maximize learning of the students.
3) Package the off-line materials used by the students with an eye toward easy utilization at the student CAI station and quick reference in the off-line clinical situation.
4) Reproduction of multiple copies of the photomicrographs of the course into 16 mm micro film cartridges suitable for presentation to learners on the 1500 instructional system.

FLOW CHART FOR THE LABORATORY DIAGNOSIS OF MALARIA



KEY TO FLOW CHART

1. Sign on
2. Introduction to course: list of topic areas
3. Has student completed smear technique?
4. Did student elect to enter smear technique?
5. Diagnostic test: smear technique
6. Was student performance satisfactory?
7. Instruction: smear technique
8. Does the student wish to review?
9. Review: blood smear technique
10. Criterion test: smear technique
11. Is remedial work required?
12. Remedial: smear technique
13. Has criterion been reached?
14. Has student completed stage instruction?
15. Did student elect to enter stage instruction?
16. Diagnostic test: stage instruction
17. Was student performance satisfactory?
18. Instruction: stage discrimination
19. Does the student wish to review?
20. Review: stage discrimination
21. Stage drill
22. Has student requested assistance?
23. Assistance: stage drill
24. Has student completed the drill?
25. Criterion test: stage discrimination
26. Has student completed species diagnosis?
27. Does tudent wish to enter species diagnosis
28. Diagnostic test species diagnosis
29. Was student performance satisfactory?
30. Instruction: diagnostic properties
31. Is further instruction required?
32. Instruction: artifact discrimination
33. Is further instruction required?
34. Does the student wish to review?
35. Review: species diagnosis
36. Species drill
37. Criterion test. species diagnosis
38. Has student completed all sections?
39. Off line microscope test
40. Is remedial work required?
41. Remedial: species diagnosis
42. Sign off

Appendix B

Example A:

A slide showing the drawing of a mature schizont and an immature schizont is projected onto the screen.

Computer: The striking difference between the schizont at the left of the slide and the schizont at the right is:
a. the number of chromatin masses
b. the size of the parasites
c. the size of the RBC
d. the color of pigment in the parasites' cytoplasm
Type the letter of the correct answer

Student: *c*

Computer: The size of the RBC will vary at times, but not always. One of the above choices is always true. Try again.

Student: *b*

Computer: It's true that the size of the mature schizont may be greater than the younger form, but this is not always the case. Try again.

Student: *a*

Computer: Good

Appendix B

(Continued)

Example B:

A photomicrograph of a thin blood smear is displayed on the screen.

Computer:	Type the name of the stage shown on the slide
Student:	*Schizont*
Computer:	No . . . (pause for a different slide to be displayed) this is an example of a schizont. You can identify this stage by the multiple chromatin masses that have been produced by nuclear division. Try another stage. (The original slide is shown again.)
Student:	*Trophazoite*
Computer:	Troph o zoite This is a trophozoite, but is it an early or late trophozoite?
Student:	*Late*
Computer:	No. If it isn't a late trophozoite, it must be an _ _ _ _ _ trophozoite.
Student:	*Early*
Computer:	Right.

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10. DISTRIBUTION

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

This interim report covers the period from May 1, 1967, through December 31, 1967, and outlines the progress made toward achieving specific objectives including the development and evaluation of a teleprocessed computer-assisted instruction course in the recognition of malaria parasites. Segments developed use Coursewriter as an author language and are presented via a display terminal that permits two-way communication with an IBM 1410 computer located at Penn State's Computer Building, University Park, Pennsylvania. In addition to typewriter printout and keyboard the student station provides selected voice messages and slide images under program control. Project is scheduled for completion June 30, 1968.

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